CLAIMS

1. A wearable action-assist device which assists or executes an action of a wearer by substituting for the wearer, comprising:

an action-assist tool having an actuator which gives power to the wearer;

a biosignal sensor detecting a wearer's biosignal;

a biosignal processing unit acquiring, from the biosignal detected by the biosignal sensor, a nerve transfer signal for operating a wearer's muscular line skeletal system, and a myoelectricity signal accompanied with a wearer's muscular line activity;

an optional control unit generating a command signal for causing the actuator to generate power according to a wearer's intention by using the nerve transfer signal and the myoelectricity signal which are acquired by the biosignal processing unit; and

a driving current generating unit generating a current according to the nerve transfer signal and a current according to the myoelectricity signal, respectively, based on the command signal generated by the optional control unit, to supply the respective currents to the actuator.

2. The wearable action-assist device according to claim 1 wherein the wearable action-assist device comprises a physical quantity sensor which detects a physical quantity related to the action of the wearer.

3. The wearable action-assist device according to claim 1 wherein the biosignal processing unit

comprises:

a unit which amplifies the biosignal;

a first filter which extracts the nerve transfer signal from the biosignal; and

a second filter which extracts the myoelectricity signal from the biosignal.

4. The wearable action-assist device according to claim 1 wherein the driving current generating unit supplies to the actuator a total current of a pulse current which is generated according to the nerve transfer signal and a current which is generated so as to be substantially proportional to the myoelectricity signal, and causes operation of the actuator to start by supplying the pulse current.

5. The wearable action-assist device according to claim 4 wherein the driving current generating unit generates, when starting the supply of current to the actuator, the pulse current or the total current such that the pulse current or the total current is larger than a lower limit of current that is capable of driving the actuator.

6. The wearable action-assist device according to claim 2 wherein the wearable action-assist device comprises a database in which a given correspondence relation between each of respective standard parameters of a series of minimum action units (phases) which constitute a wearer's action pattern classified as a task, and a power application rate (power assist rate) of the actuator is stored, and

wherein the optional control unit estimates a

phase of a task which the wearer intends to perform, by comparing the physical quantity detected by the physical quantity sensor with a standard parameter stored in the database, the optional control unit determining a power assist rate according to the estimated phase based on the correspondence relation, and generating a command signal for causing the actuator to generate a power according to the power assist rate.

7. The wearable action-assist device according to claim 1 wherein, when the wearer operates by reflexes, the driving current generating unit supplies a current for driving the actuator in an opposite direction of the operation concerned for a predetermined time, and, after the predetermined time, the driving current generating unit supplies a current for driving the actuator in a direction towards the operation.

8. A wearable action-assist device which assists or executes an action of a wearer by substituting for the wearer, comprising:

an action-assist tool having an actuator which gives power to the wearer;

a biosignal sensor detecting a wearer's biosignal;

a physical quantity sensor detecting a physical quantity related to the action of the wearer;

an optional control unit generating a command signal for causing the actuator to generate power according to a wearer's intention, by using the biosignal detected by the biosignal sensor,

a database storing respective standard parameters of a series of minimum action units (phases)

which constitute a wearer's action pattern classified as a task;

an autonomous control unit estimating a phase of the wearer's task by comparing the physical quantity detected by the physical quantity sensor with a standard parameter stored in the database, and generating a command signal for causing the actuator to generate power according to the estimated phase;

a signal combining unit combining the command signal from the optional control unit and the command signal from the autonomous control unit; and

a driving current generating unit generating a total current according to a total command signal from the signal combining unit, to supply the total current to the actuator.

9. The wearable action-assist device according to claim 8 wherein a plurality of hybrid ratios of the command signal from the optional control unit and the command signal from the autonomous control unit which have a given correspondence relation with the respective standard parameters of the series of phases are stored in the database, and the signal combining unit combines the command signal from the optional control unit and the command signal from the autonomous control unit so as to meet a hybrid ratio which is determined based on the correspondence relation according to the phase estimated by the autonomous control unit.

10. The wearable action-assist device according to claim 8 wherein the wearable action-assist device comprises a biosignal processing unit which acquires, from the biosignal detected by the biosignal sensor, a nerve

transfer signal for operating a wearer's muscular line skeletal system and a myoelectricity signal accompanied with a wearer's muscular line activity, and the driving current generating unit causes operation of the actuator to start by supplying a pulse current which is generated according to the nerve transfer signal acquired by the biosignal processing unit.

11. The wearable action-assist device according to claim 10 wherein the driving current generating unit generates the pulse current or the total current so that it may become larger than a lower limit of current which can drive the actuator when starting supply of current to the actuator.

12. The wearable action-assist device according to claim 8 wherein a plurality of power application rates (power assist rates) of the actuator, which have a given correspondence relation with the respective standard parameters of the series of phases, are stored in the database, and the signal combining unit determines a power assist rate according to the phase of the task estimated by the autonomous control unit based on the correspondence relation, and the optional control unit, and combines the command signal from the optional control unit and the command signal from the autonomous control unit so as to meet the determined power assist rate.

13. The wearable action-assist device according to claim 8 wherein, when the wearer operates by reflexes, the driving current generating unit supplies a current for driving the actuator in an opposite direction of the operation concerned for a predetermined time, and, after

the predetermined time, the driving current generating unit supplies a current for driving the actuator in a direction towards the operation.

14. A method of controlling a wearable action-assist device which assists or executes an action of a wearer by substituting for the wearer, wherein an action-assist tool having an actuator which gives power to the wearer is attached to the wearer, the method comprising the steps of:

detecting a wearer's biosignal;

acquiring, from the detected biosignal, a nerve transfer signal for operating a wearer's muscular line skeletal system and a myoelectricity signal accompanied with a wearer's muscular line activity;

generating an optional command signal for causing the actuator to generate power according to a wearer's intention by using the nerve transfer signal and the myoelectricity signal which are acquired; and

generating a current according to the nerve transfer signal and a current according to the myoelectricity signal, respectively, based on the generated optional command signal, to supply the respective currents to the actuator.

15. The method of controlling the wearable action-assist device according to claim 14 wherein a total current of a pulse current which is generated according to the nerve transfer signal and a current which is generated so as to be substantially proportional to the myoelectricity signal is supplied to the actuator, and operation of the actuator is caused to start by supplying the pulse current.

16. The method of controlling the wearable action-assist device according to claim 15 wherein, when starting the supply of current to the actuator, the pulse current or the total current is generated such that the pulse current or the total current is larger than a lower limit of current that is capable of driving the actuator.

17. The method of controlling the wearable action-assist device according to claim 14 wherein the method further comprises the steps of: detecting a physical quantity related to the action of the wearer; estimating a phase of a task which the wearer intends to perform, by comparing the physical quantity with each of respective standard parameters of a series of minimum action units (phases) which constitute a wearer's action pattern classified as a task; determining a power assist rate according to the estimated phase based on the correspondence relation; and generating a command signal for causing the actuator to generate a power according to the power assist rate.

18. The method of controlling the wearable action-assist device according to claim 14 wherein, when the wearer operates by reflexes, a current for driving the actuator in an opposite direction of the operation concerned for a predetermined time is supplied, and, after the predetermined time, a current for driving the actuator in a direction towards the operation is supplied.

19. A method of controlling a wearable action-assist device which assists or executes an action of a wearer by substituting for the wearer, wherein an action-

assist tool having an actuator which gives power to the wearer is attached to the wearer, the method comprising the steps of:

detecting a wearer's biosignal;

detecting a physical quantity related to the action of the wearer;

generating an optional command signal for causing the actuator to generate power according to a wearer's intention, by using the biosignal;

estimating a phase of the wearer's task by comparing the physical quantity with each of respective standard parameters of a series of minimum action units (phases) which constitute a wearer's action pattern classified as a task;

generating an autonomous command signal for causing the actuator to generate power according to the estimated phase;

combining the optional command signal and the autonomous command signal to form a total command signal; and

generating a total current according to the total command signal to supply the total current to the actuator.

20. The method of controlling the wearable action-assist device according to claim 19 wherein a plurality of hybrid ratios of the optional command signal and the autonomous command signal which have a given correspondence relation with the respective standard parameters of the series of phases are predetermined, a hybrid ratio is determined based on the correspondence relation according to the estimated phase, and the optional command signal and the autonomous command signal

are combined so as to meet the determined hybrid ratio.

21. The method of controlling the wearable action-assist device according to claim 20 wherein, when starting supplying of a current to the actuator, the pulse current or the total current is generated so that it may become larger than a lower limit of a current which can drive the actuator.

22. The method of controlling the wearable action-assist device according to claim 19 wherein a plurality of power application rates (power assist rates) of the actuator, which have a given correspondence relation with the respective standard parameters of the series of phases, are stored, and a power assist rate is determined according to the estimated phase of the task based on the correspondence relation, and the optional command signal and the autonomous command signal are combined so as to meet the determined power assist rate.

23. The method of controlling the wearable action-assist device according to claim 19 wherein, when the wearer operates by reflexes, a driving current for driving the actuator in an opposite direction of the operation concerned is supplied for a predetermined time, and after the predetermined time, a driving current for driving the actuator in a direction towards the operation is supplied.

24. A program for causing a computer to execute the method according to claim 14 for controlling the wearable action-assist device.

25. A program for causing a computer to execute the method according to claim 19 for controlling the wearable action-assist device.